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SIMON NEWCOMB: A TRIBUTE[1] TO HIS PERSONALITY AND ACCOMPLISHMENTS

By Dr. W. W. CAMPBELL

PRESIDENT EMERITUS OF THE UNIVERSITY OF CALIFORNIA, AND DIRECTOR EMERITUS OF THE LICK OBSERVATORY

SIMON NEWCOMB, the astronomer, was born in Canada, on the north coast of Nova Scotia, but he was almost wholly of New England descent, through many generations, and his entire adult life was lived in the United States. The first Simon Newcomb was born in Massachusetts or Maine about 1666. His descendants formed the habit of naming their eldest sons after him, and except for the fact that his father was a younger son, the astronomer would have been the sixth Simon Newcomb in unbroken lineal descent. His paternal grandfather, Simon Newcomb, migrated from New England to Nova Scotia in 1761. He was a stonecutter, but he was credited "with unusual learning and with having at some time taught school." He possessed a small collection of books on serious subjects, including an algebra, a Euclid and a volume on navigation, which were destined to influence profoundly the life of the grandson.

The astronomer's father, John Newcomb, was by profession a country school teacher. He had the distinction of being an early exponent of the principles of eugenics. After careful consideration he concluded that a man should marry at the age of 25, and that the wife should have certain temperamental characteristics and be mentally gifted. When John Newcomb "found the age of 25 approaching he began to look about. There was no one in his village who satisfied

[1] Address at the unveiling of the bust of Simon Newcomb in the Hall of Fame at New York University, May 28, 1936. Many items in this tribute have been taken from my brief biography of Simon Newcomb published in *Memoirs of the National Academy of Sciences*, Volume XVII, 1924.—W. W. C.

the requirements. He therefore set out afoot to discover his ideal." His researches were in vain until they had extended nearly a hundred miles from home and into the neighboring province of New Brunswick. Hearing the strains of music from a church he went in, and there found his future wife, Emily Prince, in the person of the organist and leader of the singing. Emily's father had migrated from Maine to New Brunswick early in life.

There is evidence in abundance that our Simon Newcomb (born on March 12, 1835, died on July 11, 1909) was early imbued with the New England philosophy, "life is real, life is earnest"; and those who had the privilege of knowing him through the last decade or two of his great fame had no reason to think that at any time in his seventy-four years did the influence of this philosophy decrease by "one jot or tittle." Simon was well endowed by nature: he was a precocious child and boy, at least as to subjects mathematical in nature; and, though strong of body, he had no great love for physical labor, but he did have a passion for intellectual endeavor.

Concerning his early education Simon Newcomb later in life wrote: "What we now call school training, the pursuit of fixed studies at stated hours under the constant guidance of a teacher, I (Simon) could scarcely be said to have enjoyed. For the most part, when I attended my father's school at all, I came and went with entire freedom. . . ."

Simon's studies in algebra, in Euclid, in navigation and in astronomy (from books found in his grandfather's house and an old book on astronomy secured for him by his father) were pursued eagerly and without the guidance of an instructor.

Following the lamented and early death of Simon's talented mother, the father had come to "The States" in quest of better fortune, leaving Simon behind in the position of an apprentice. For reasons which did him utmost credit, the son, at the age of eighteen and one half years, soon followed the father, who had settled in eastern Maryland. There Simon Newcomb began his distinguished educational career as the teacher of a country school, early in the year 1854. Three decades later he was professor of mathematics and astronomy in Johns Hopkins University, then the American university of highest rating in graduate studies.

In his first summer vacation he paid a visit to the nearby national capital, little dreaming it would ever be his home. He resided there during the last 48 years of his life. He "went as far as the gate of the astronomical observatory, and looked wistfully in, but feared to enter." Only seven years later he became an astronomer in that observatory, with rank and title of professor.

In his three years of teaching he devoted every spare hour to such books of high merit as he could secure or gain access to. These related more especially to books on mathematical subjects, including Sir Isaac Newton's "Principia," and to a few works on political economy.[2] Before the passing of much time he made the acquaintance and won the confidence of Professor Joseph Henry, the distinguished head of the Smithsonian Institution, and of Mr. Hilgard, officer in charge of the Coast Survey. The latter recommended him for appointment as a computer in the office of the Nautical Almanac, then located in Cambridge, Massachusetts; and he was so appointed, on trial, in January, 1857, at $30 per month. This humble start was all he needed.

The splendid astronomical career of Simon Newcomb could have been predicted with confidence, from the character of the first problem he attacked, in 1857, as a side issue, while earning his modest living as a computer on the Nautical Almanac. It was to astronomers then, and still is, a curious and surprising fact that Nature—in other words the processes of astronomical evolution—had not caused a large or major planet to exist, and revolve around the Sun, in an orbit located between Mars's orbit and Jupiter's orbit. In due time, from 1801 up to Newcomb's date, 1857, 42 little planets, or asteroids, were discovered to be revolving around the Sun in the region defined. They seemed to be doing their part in taking the place of one "missing" major planet. A German astronomer, Olbers, had proposed, early last century, the hypothesis that the missing major planet had perhaps, for some unknown reason, exploded in the distant past, and that the minor planets were the fragments thereof.

[2] Newcomb early became a serious and thorough student of economic subjects. His writings in the field of economics are numerous, and many of them have been accorded high rank by leading economists. They include several volumes and a great many magazine articles on timely subjects. In 1865 appeared his first contribution, a volume of 222 pages, entitled "A Critical Examination of our Financial Policy during the Southern Rebellion." "The A B C of Finance," issued in Harper's Half Hour Series, bears date 1877. His "Principles of Political Economy," an extensive treatise of 548 pages, came out in 1886. His contributions to the *North American Review* began in 1866, with a thoughtful article on "Our Financial Future"; and later articles considered such subjects as the "let alone" principle in economics, national debts, the standard of value, the principles of taxation, science and government, our antiquated method of electing a President, etc. Other leading journals contain articles on life insurance, the silver question, the organization of labor, schools of political economy, etc. Newcomb was a lecturer on Political Economy in Harvard College in 1879–80. He was elected president of the Political Economy Club of America in 1887. The first prize, $150, of two citizenship prizes offered by the Anthropological Society of Washington, was awarded to Newcomb in 1894 for his essay on "The Elements Which Make up the Most Useful Citizen of the United States." The indications are that if Newcomb had chosen economics as his chief field of endeavor he would have been in the front rank of economists.

If such had been the case, the several pieces of the exploded body must have been *together* at the point and instant of explosion; and the elliptic orbits of the several pieces in the period immediately following such explosion must all have passed through that common point. In the succeeding thousands and millions of years, the gravitational attractions of the major planets, Jupiter, Saturn, Mars, Earth, etc., would have modified quite materially the orbits of the several fragments. With great mathematical skill, and at the cost of calculations made upon an heroic scale, Newcomb carried back the orbits of several of the little planets to what they were many hundreds of thousands of years ago. In 1860, at age slightly under 25, he published the reasoned conclusion that those asteroids had never passed through one and the same point, and therefore that the Olbers hypothesis as to the origin of the asteroids was not tenable.

As another side issue, in Cambridge, Newcomb immediately registered as a student in mathematics in the Lawrence Scientific School of Harvard College, and was graduated as a bachelor of science a year and a half later. I mention this only because it appears to have been his sole experience as the beneficiary of formal education.

At age 26 years Newcomb was appointed to a full professorship on the staff of the Naval Observatory, in Washington, then easily the leading observatory in the United States. The appointment did not appeal to him strongly, as his tastes and talents were along the line of mathematical astronomy, in contradistinction to observational astronomy. However, in the several volumes entitled, "Astronomical and Meteorological Observations Made at the United States Naval Observatory," Washington, in the years 1861 to 1870, inclusive, one finds abundant evidence of Newcomb's great energy in using the instruments for which he was responsible, and in the prompt publication of the results achieved. His writings revealed a remarkably clear and thorough comprehension of many important astronomical problems ahead, and of methods of attacking them with greatest promise of success. He early urged a homogeneity of observing programs and methods for the Naval Observatory, so that the results would acquire and retain their maximum strategic values in the solution of many problems dealing not only with the bodies composing our solar system, but with thousands of the brighter stars in our great stellar system; and his proposals were approved and put into effect by the naval officers who served, in succession, as superintendents of the Observatory.

The devoting of the resources of the Naval Observatory to the determination of star positions and to the special needs of the Navy Department led naturally to the neglect of that side of astronomical investigation which requires powerful telescopes. This fact was called to the attention of the superintendent of the observatory by Professor Newcomb in 1868, and again in 1869, with the recommendation that the observatory procure a refracting telescope as large as the already celebrated maker, Alvan Clark, would undertake to construct. These recommendations led ultimately to the making of a financial appropriation for the purpose by the Congress of 1870–71, and to the complete installation in 1873 of a telescope with objective lenses 26 inches in diameter, then by far the largest and most powerful refracting telescope in existence.

While the 26-inch telescope was in the planning state Professor Newcomb realized that the discrepancies between the observed positions of the moon and the positions as predicted in the then best tables (Hansen's) for the moon's motion had become a serious matter, and at his request it was arranged that he should be relieved from the duty of making any further observations with the observatory's existing instruments, and from other observatory work, to let him devote his time to a more thorough and comprehensive investigation of the moon's motion. The advancement of the lunar problem developed into one of the leading undertakings of his life; it received an extensive share of his efforts in many of his last 39 years.

Professor Newcomb was appointed superintendent of the "Nautical Almanac" in 1877. He has written:

> The change was one of the happiest of my life. I was now in a position of recognized responsibility, . . . where I could make plans with the assurance of being able to carry them out. . . . The program of work which I mapped out, involved as one branch of it a discussion of all the observations of value on the positions of the Sun, the Moon, and (the 8 major) planets, and incidentally on the bright fixed stars, made at the leading observatories of the world since the year 1750 . . . the number of meridian observations on the Sun, Mercury, Venus, and Mars alone numbered 62,030. They were made at the observatories of Greenwich, Paris, Königsberg, Poulkovo, Cape of Good Hope, Washington and seven others—13 in all. The other (principal) branches of the work were . . . the computation of . . . the perturbations of the various planets by each other.

Such stupendous tasks, the largest and by far the most ambitious ever undertaken by any astronomer up to that time or since, could not, of course, be performed by one individual unaided. On this point Newcomb wrote in 1882: "Both Congress and the Navy Department have supplied all the assistance which has been asked for, and a force of from eight to ten computers, some of the highest order of mathematical ability, has been actively employed during the past year, and may, if necessary, be increased in the future." In his autobiography he has spoken most

generously of the contributions made by his chief assistants in this work.

It is not possible to give here an adequate impression of the immense labor involved in carrying to completion the programs of lunar and planetary investigations referred to. In fact, a correct impression can not be gained, even at the price of a careful perusal of the voluminous papers describing the results, unless the reader himself has dipped into the complexities of gravitational astronomy and has had extensive experience in making astronomical calculations. It means relatively little to say that the work was of herculean and monumental proportions. Some of the investigations are described in the publications of the United States Naval Observatory, others in the various astronomical journals, and yet others in special mediums; but the theory and tables of the planetary and lunar motions are contained chiefly in a special series known as the "Astronomical Papers," of which eight and one-half large quarto volumes exist. These papers continue to rank amongst the priceless treasures of astronomical literature.

Technically and administratively a naval officer, Newcomb was automatically retired from the "Nautical Almanac" superintendency and service on reaching the age of 62 years, in 1897, but fortunately his influence was potent in having certain unfinished items on the great program carried through to substantial completion in the "Nautical Almanac" office. His chief regret was that his studies on the motion of the moon, the most difficult of all studies having to do with the motions of the celestial bodies, was left unfinished. Fortunately, the Carnegie Institution of Washington, from time of its organization in 1902, made annual grants to Professor Newcomb for computing assistance and other facilities to carry on his lunar program; and it is a matter for congratulation that he was able to complete this work, under the patronage of the Carnegie Institution, and to prepare the results for publication, less than a month before his death in 1909, at the age of 74 years. Newcomb was fully aware that his results for the elements of the Moon's motion did not enable him to predict the future motion of the Moon with utmost precision. The gravitational interactions of the Earth and the Moon are so complicated, principally because the two bodies are relatively so close together, and concurrently for other and as yet not accurately determinable conditions within the bodies, that with the passing of time discrepancies develop between the predicted positions of the Moon and its actually observed positions. Newcomb's results were of course a great improvement upon those secured by earlier students of the subject.

The commanding place in astronomical science attained by Professor Newcomb is accurately indicated by the long list of honors conferred upon him, the number and the character of the learned societ in which he held honorary memberships, and in t number of honorary academic degrees received, Ne comb stood alone in America, and in a very sm company in the world. He was an honorary memb of more than 40 academies of science and other simi organizations in some 18 nations; and he held ho orary doctorate degrees from at least 17 leading u versities in 10 nations.

The high esteem in which Newcomb was held by h astronomical colleagues and by devotees of other phy cal sciences is attested by the honors they paid hi Limitations of time permit me to mention only t of the many such items.

The American Astronomical Society was found in 1899. Newcomb was elected, in effect by acclam tion, as the society's first president, and his electi was repeated annually for six years until 1905, wh he requested and insisted on relief from the duty.

The Astronomical Society of the Pacific, with me bership consisting of several hundred professio and private astronomers in many countries, establish the Bruce Gold Medal Foundation in 1897. The ru of award made this medal international in charact the directors of six leading observatories—Greenwi Paris, Berlin, Harvard, Lick and Yerkes—were ca upon to nominate each a limited number of astro mers worthy to receive the medal, and the directors the society must by the society's statutes select recipient of the medal from this list. For the ini award of the medal the director of each of the observatories nominated Simon Newcomb as his f choice. As the president of the Astronomical Soci at that time announced, "The Directors of the Soci could but set the seal of their approval upon the v dict of his peers, and award the first Bruce Gold Me to Professor Simon Newcomb."

Newcomb's superlative program of investigati concerned the solar system, but the basic needs of t great program extended to the stellar system. devoted much time and successful endeavor to c parative studies of the accurately observed positi not only of the members of the solar system, but a of thousands of the brighter stars distributed o the entire sky, made at a score or more of obse tories, in order that the small systematic errors those literally hundreds of thousands of observati should be eliminated, and the whole of the obse tional data be rendered as nearly homogeneous as p sible, to let all these observations be applied to solution of many of the great astronomical probl of his time. In 1902 he published an important ume on "The Stars—A Study of the Universe," wi

twenty chapters made notable contributions to our understanding of as many divisions in the astronomy of our great stellar system.

Newcomb's interest in the progress of mathematics was strong throughout his life. While an assistant in the "Nautical Almanac" office at Cambridge, he contributed valuable articles to the mathematical journals, especially on the theory and practice of probabilities, a subject applicable to every division of astronomical science. His contributions to pure mathematics were limited by other demands upon his time, and the subjects that received his attention were mainly those which related more or less intimately to celestial mechanics and probabilities. There could be no question, however, of a great underlying mathematical ability. Professor Cayley, one of the most eminent mathematicians of Cambridge University, when presenting the Gold Medal of the Royal Astronomical Society of London to Professor Newcomb in 1874, three years before Newcomb became superintendent of the "Nautical Almanac," spoke of Newcomb's memoir on the theory of the perturbations of the moon which are due to the gravitational attractions of the planets, in these words: "The memoir is, from the boldness of the conception and beauty of the results, a very remarkable one, and constitutes an important addition to theoretical dynamics." I have already mentioned the fact that Simon Newcomb was a professor of mathematics and astronomy in Johns Hopkins University in 1884, and later—altogether during 11 years.

Newcomb possessed in remarkable degree the power of writing successfully for the intelligent public. Dozens of his articles on subjects of timely interest, not "written down" to the level of the readers, but in logical, admirable, understandable language, appeared in the leading American magazines and newspapers.

Newcomb wrote several splendid text-books on astronomy. His "Popular Astronomy," a comprehensive treatise on the fundamental principles of astronomy, issued in 1878, has, in my opinion, never been equaled in merit by any other book aiming to cover, in general, the same ground. Notwithstanding the tremendous advances of the past fifty-eight years in astronomical science, the original edition remains a book which all students of astronomy could read with profit and pleasure. It has passed through eight editions in this country, it has been translated into several languages, and in Germany, between 1881 and 1922, it was made the basis of seven editions brought up to date by German astronomers.

Newcomb's work, driven by untiring energy and guided by philosophic intelligence and dependable judgment for more than a half century, placed him at the head of his profession in America, and gave him membership in a small class of the most productive astronomers of all countries and all centuries. A survey of his activities must lead to the conclusion that Simon Newcomb was intellectually a giant; and fortunately this rare quality was accompanied by deep and abiding interest, by clear visions of objectives, and by the exercise of executive ability of an extremely high order.

In closing, I venture to repeat and record the opinion prevailing throughout the learned world that Simon Newcomb was not only the leading American astronomer but the leading American scientist up to and including his time.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SEATTLE MEETING OF THE PACIFIC DIVISION. II

By Dr. J. MURRAY LUCK
SECRETARY

American Association of Economic Entomologists, Pacific Slope Branch

(Report by J. F. Lamiman)

The meetings were attended by about seventy-five entomologists, including the national president, L. S. McLaine. Some thirty-five papers were presented, the most interesting of which was the invitation address by Professor R. W. Doane on "Forty-five Years of Entomology."

The papers presented were on an unusually wide range of subjects, with four devoted to wireworms and their control and four on codling moth control.

In addition to the above, A. L. Strand and J. H. Pepper presented a new criterion for the classification of petroleum oil sprays; G. F. MacLeod reported on some quantitative problems of insect injuries to potatoes; R. N. Chapman discussed egg eating as a factor in the life cycle of flour beetles; F. P. Keen and R. L. Furniss reported on the effects of sub-zero temperatures upon populations of the western pine beetle; F. R. Lawson and J. C. Chamberlain discussed the flight habits and dispersal of the beet leafhopper; C. W. Getzendaner reported on recent developments in parasitizing the European earwig, and G. Allen

Mail discussed the use of thiodiphenolamine as a mosquito larvicide.

Officers elected for the ensuing year are: *President,* E. J. Newcomer; *Vice-president,* J. R. Eyer; *Secretary-treasurer,* J. F. Lamiman.

American Society of Ichthyologists and Herpetologists, Western Division

(Report by Arthur Svihla)

The eighth annual meeting of the western division of the Society of Ichthyologists and Herpetologists was held with the Pacific Division, American Association for the Advancement of Science, at the University of Washington, Seattle. One of the outstanding features of the meeting was the presentation of papers dealing with the fisheries problems of the Pacific Northwest, with the entire afternoon session given over to this function. Twenty-six papers were read during the course of the meeting.

The following were elected officers for the coming year:

President, Rolf Bolin, Hopkins Marine Station, Pacific Grove, Calif.; *Vice-president,* Major Chapman Grant, San Diego, Calif.; *Secretary-treasurer,* Arthur Svihla, State College of Washington.

Pacific Northwest Bird and Mammal Society

(Report by R. C. Miller)

The society held a half-day session on Thursday morning in conjunction with the Cooper Ornithological Club. E. D. Lumley reported his studies of the morning awakening of birds. Elizabeth L. Curtis described the structure of the sclerotic ring of the eye in a number of orders of birds. R. C. Miller reported observations on albatrosses and other sea birds. Barbara D. Blanchard described the annual cycle of behavior in two races of white-crowned sparrow. T. H. Scheffer discussed breeding records of the Pacific Coast pocket gophers. J. E. Schwartz reported on recent studies of the Roosevelt elk in the Olympic Mountains. P. P. Macy discussed the flora and fauna of the Olympics. On Thursday afternoon the society participated with several other biological societies in a joint symposium on "Plant and Animal Distribution on the Pacific Coast." W. T. Shaw, with W. P. Taylor, represented the society with a paper on the distribution of birds and mammals in the state of Washington as influenced by the topography of the state.

San Francisco Aquarium Society

(Report by A. W. Herre)

A dinner meeting on the evening of June 19 was held jointly with the Seattle Aquarium Society. It was largely attended by members from Seattle and representatives of the Portland and San Francisco societies. An address on the habits of rare and interesting tropical fishes, both marine and fresh water, suitable for aquarium study and culture, was presented by Dr. Albert W. Herre, of Stanford University. He also exhibited specimens of the smallest fishes in the world, minute gobies from Luzon, P. I. Dr. Trevor Kincaid, of the University of Washington, gave a lecture on the marine fishes and invertebrates of Puget Sound available for aquarium purposes, illustrating his remarks with colored lantern slides.

The Western Society of Naturalists

(Report by E. G. Moberg)

On Thursday afternoon, with the Botanical Society of America, the Cooper Ornithological Club and the Pacific Northwest Bird and Mammal Society, the society participated in a symposium on "Plant and Animal Distribution on the Pacific Coast." The following topics were discussed: "Geographic Distribution of Fresh-water Copepods on the Pacific Coast," by Trevor Kincaid, University of Washington; "The Distribution of Amphibia in the State of Washington," by James R. Slater, College of Puget Sound; "Life-forms and Life-zones of Plants in Western Washington," by G. N. Jones, University of Washington; and "The Distribution of Birds and Mammals in the State of Washington as Influenced by the Topography of the State," by Walter P. Taylor, of the U. S. Biological Survey, and William T. Shaw, of Fresno State College.

At sessions held on June 19, twenty-three miscellaneous papers were presented.

American Phytopathological Society, Western Division

(Report by C. E. Owens)

At the twentieth annual meeting of the society, the following officers were elected: B. A. Rudolph, *President;* C. W. Bennett, *Vice-president;* L. D. Leach, *Secretary-treasurer;* J. W. Hotson, *councilor.* Three half-day sessions were held, and twenty-four papers were presented. H. P. Severin and J. C. Freitag discussed the transmission of western celery mosaic by aphids and the properties of the virus, also the aphid vectors of celery calico. A. B. Hatch discussed mycorrhizal fungi, calling attention to the greatly increased absorbing surface on pine roots induced by these fungi and the fact that trees can not thrive in infertile soil in their absence. William Newton described the effects on tomato of a particularly virulent strain of the "potato X" virus. L. J. Klotz described an injury to citrus fruits caused by water. H. S. Fawcett and L. J. Klotz reported a new species of *Candelospora* causing decay in citrus fruits. G. A. Huber made a progress report on the control of

narcissus and bulbous iris leaf diseases by Bordeaux-Penetrol spray and on the spread and adhesiveness of this spray material. This combination proved the most satisfactory of any materials tried. J. Kienholz and Leroy Childs conducted trials of various copper sprays for pea and apple scab, considering both their effectiveness and tendency to cause injury. A 2-2-2-50 combination of copper phosphate, lime and bentonite proved best. R. B. Streets discussed attempts to diagnose cotton root-rot in soils by screening out the sclerotia and indicated the apparent usefulness of heavy applications of ammonium sulfate in aiding recovery of fruit and nut trees from root-rot. R. Sprague reported on foot-rot disease of cereals in certain coastal valleys of Oregon, also on some mycological aspects of species of *Mastigosporium* on Gramineae. G. W. Fisher found that certain smut spores taken from herbarium specimens were viable after periods ranging up to 25 years. S. M. Zeller outlined studies on bark necrosis and fruit pit of pear, reported simultaneous infection of strawberry by Grinkle and Yellows, and described a new genus of Gasteromycetes. Karl D. Butler described a disease of the inflorescence of the date palm caused by a *Helminthosporium* and reported studies on ash tree cankers. Several papers, chiefly of mycological interest, were presented as follows: J. W. Hotson, "A New Species of *Arachniotus* Isolated from Contaminated Milk"; R. H. Tschudy, "Cultural Studies of the Genus *Chaetomium*"; and studies of several groups of fungi as they occur in western Washington namely, "Operculate Discomycetes," by Leon C. Snyder; "The Genus *Inocybe*," by D. E. Stuntz; "Polypores," by J. R. Roberts; and "Hydnums," by W. M. Lanphere.

American Society of Plant Physiologists, Western Section

(Report by Harry F. Clements)

The Western Section of the American Society of Plant Physiologists made its bow to the scientific world with two full days of meetings. It spent one day in a joint meeting with the Western Society of Soil Science, with attendance ranging from 35 to 70 at any one time, and during the second day it listened to papers of its members with as many as 50 attending. Officers of the section are as follows: *Chairman,* D. R. Hoagland, University of California; *Vice-chairman,* J. P. Bennett, University of California; *Secretary,* H. F. Clements, State College of Washington.

All told, there were twenty-one papers presented, including two invitation addresses by the respective chairmen of two cooperating societies. Dr. Hoagland described the work now under way at the University of California dealing with the abnormalities in plants resulting from a lack of zinc in the salt solution. He and his associates were able to reproduce these abnormalities by growing plants in solutions lacking zinc. It appears, however, that this was not a simple cause-and-effect phenomenon, since it was discovered that a hormone, free of zinc, was likewise capable of correcting the little-leaf condition of the plants used. Dr. R. E. Stephenson, chairman of the Soils Section, described the many physical factors of the Oregon soils which modify moisture conditions of these soils and in turn the nutrition of the plants.

Another report showed that xylem tissue carries the bromide ion, since for several hours after girdling the stem, the ion movement upward continued. It is after some forty-eight hours that a decrease in rate is noted, indicating that the girdle somehow affects the water course.

Some attention is being given the matter of toxic spray residues on soils of orchards. The Oregon and Washington experiment stations are studying the effects of such material as arsenic, lead and copper on plants. Efforts were made to determine the distribution of these materials in the soil as well as within the plant. This is a timely problem, and it is certain that unless inorganic sprays are dispensed with, some very radical changes in orchard management will have to be made.

In this connection work done with herbicides is of note. The toxicity of borates and arsenates is markedly influenced by the texture of the soil. Toxicity is great in coarse soils and relatively slight in heavy soils. The chlorates, on the other hand, do not appear to be affected by the texture of the soil but rather by its productivity.

The many difficulties associated with pecan production were reviewed, and from the results it appears that a proper manipulation of the carbohydrate-nitrogen relations results in a better filling of the nuts.

These, together with the many other papers of interest, stimulated a considerable amount of discussion and contributed much to the success of the meeting.

Botanical Society of America, Pacific Division

(Report by George B. Rigg)

Sessions of the Pacific Section of the Botanical Society of America were held at the University of Washington on June 17, 18 and 19. President T. C. Frye presided. Officers elected for next year are: *President,* A. H. Hutchinson, of the University of British Columbia; *Secretary-treasurer,* L. L. Burlingame, of Stanford University; *Councilor,* H. S. Fawcett, of the California Citrus Experiment Station. The papers included a plea for conservation in publishing new species in the West; taxonomic and morphological consideration of the Characeae, the Polytrichaceae and the genera, *Eriophyllum, Arabis* and

Saxifraga; the advantages of the polygonal presentation of ecological data and of angiosperm family concepts; a mineral salt hypothesis of the rôle of mycorrhizae; a description of a cross between the native Nutka rose and a cultivated rose; an account of microsporogenesis in certain cherries; the embryology of Pleuricospora; morphological changes in Chaetomiun when grown on various media; the structure of chloroplasts in garden beets; the use of the terms *monoecious* and *dioecious;* the origin of adventitious roots in cuttings of Begonia; the recovery of HCN from citrus foliage; the acidity of the marine alga Desmarestia; the phytoplankton of sea water; diatoms as indicators of bog development; the origin and development of collenchyma strands and vascular bundles in celery; and the contributions of the National Park Service to science.

Ecological Society of America

(Report by H. de Forest)

Two half-day sessions were held, with attendance ranging from 15 to 30. Several papers dealt with the Northwest. Typical profiles of coastal sphagnum bogs of Washington and Oregon were presented, and the reconstruction of the past history of plant migrations and successions in these habitats, with the need for preservation of some of the few remaining undamaged bogs, were discussed. The relation of pink salmon in southeastern Alaska to the summer and autumn rainfall, which supplies many of the streams through surface drainage, was explained in another paper. This climatic factor has a marked influence upon the spawning salmon and the subsequent brood.

Of the papers relating to other regions, two dealt with the chaparral of the Southwest. The rate of transpirational water loss in this scrub in southern California was found to be influenced chiefly by conditions which modify the soil moisture supply. Differences in internal structure of leaves of some shrubs could be correlated quantitatively with differences in slope-exposure; altitudinal differences of almost 5,500 feet had little, or no, effect.

Another paper considered the effects of temperature on reptiles of the southwestern desert. Their toleration of high temperature was found to be slight, sand temperatures of 70° C. being lethal; no heat regulation within the body was apparent.

An investigation to obtain information accounting for the synchronous fluctuations of flour beetle populations was carried out in the Hawaiian Islands. The influence of different concentrations of prey and predators on the eating of eggs of the same species was determined.

Another paper recounted the influence of the host tree on its epiphytic community in the hygrophytic forest of Java. It was concluded that the specificity of most trees as epiphyte-carriers is so great that they may be identified by their epiphyte covering.

An interesting discussion on the question of establishing a Pacific section of this society, probably including the territory from the Rocky Mountains westward, was one feature of the program. The matter will be referred to the members for a representative decision in the autumn.

Western Psychological Association

(Report by Ralph H. Gundlach)

Four half-day sessions were held at which twenty-four experimental and theoretical papers were read. Six of the papers formed a symposium around the topic, "In What Terms Are Motives and Conflicts to be Described?" A further emphasis upon the experimental attack in the animal laboratories, and consideration in precise objective terms, was variously urged by E. R. Guthrie, Calvin P. Stone, E. C. Tolman and C. S. Hall. William Griffith held that effective clinical work could be done for the present only in terms of human wants and needs. E. R. Hilgard pointed out that human problems of motives and conflicts could not help but encroach upon problems of ethics and that all practical work in, say, mental hygiene, implies a normative base.

A session was jointly held with Anthropology. Melville Jacobs traced out the movements of language among Northwest Indians. An extensive survey of color concepts was reported by V. F. Ray. Viola Garfield illustrated the changes in the culture of a primitive society with regard to property inheritance, when that primitive society came under the jurisdiction of a government agent. W. W. Elmendorf traced out the complex beliefs and practices associated with soul recovery. William Griffith reported a greater tendency toward neuroticism among the unemployed, and among youth, whether unemployed or in school, than among adult employed and among regular soldiers. C. S. Menefee showed that the use of labels, such as fascist, communist or socialist, acts to modify the acceptance of views expressed under such labels.

The remaining two sessions dealt mainly with the problems of learning, conditioning, perception, animal psychology and sense physiology.

The retiring president, Dr. Grace M. Fernald, addressed the members at the annual banquet on the topic, "The Release of Latent Abilities: a Substitute for Motivation."

Milton Metfessel, of the University of Southern California, was elected president for the ensuing year.

Pacific Sociological Society

The principal feature of the meeting of the Pacific Sociological Society was a symposium on "Social Se-

curity," with papers on the "Need for Social Security," by Ruth FitzSimons; "Social Movements," by Joseph Cohen; "Federal Security Payroll Taxes," by James K. Hall; "The Economic Cost of Social Security," by Clement Akerman; "How to Get Social Security," by W. A. Carrothers and Charles T. Battin; "The Administration of Social Security," by Charles F. Ernst; "Administrative Problems Under the National Social Security Act," by Edmund F. Spellacy, and "How to Administer Social Security," by Kenneth C. Cole and Paul H. Landis. Nine other papers on miscellaneous topics were presented.

AMERICAN SOCIETY OF BACTERIOLOGISTS, NORTHERN CALIFORNIA–HAWAIIAN BRANCH

(Report by B. J. Olson)

The first organized meeting of western bacteriologists was held on June 19. An attendance ranging from 55 to 70 was present at the session, which embraced an excellent representation of all phases of western bacteriology and institutions in which bacteriological work is carried out. The meeting opened with an address by the chairman, P. J. Beard, who summarized the scope of activities of the Northern California-Hawaiian Branch of the Society of American Bacteriologists. He emphasized the value of close contacts between western bacteriologists, the numbers of and distribution of western bacteriologists and the enthusiastic support of these men for this type of meeting as evidenced by their contributions to the program and attendance. An expression of opinion was requested from the group in attendance as to the desirability of an annual meeting of western bacteriologists. The ensuing discussion revealed unanimous support for such an annual meeting to be held during the summer months.

The remainder of the day was occupied by the presentation of 29 scientific papers representing the following phases of the field of bacteriology—medical, general, industrial, viruses, immunology, dairy and agricultural.

A paper dealing with the rôle of desensitization in the treatment of tuberculous guinea pigs emphasized the importance of selecting the proper antigen for use in desensitization and presented the results of desensitization with various antigens. Serological studies on the antigenic relationships of tubercle bacilli were presented and also one paper on the rapid production of tuberculin in an inexpensive synthetic medium.

The bacteriological problems of the canning industry were presented and discussed. This report gave a comprehensive view of the problems confronting the canneries, the solutions found for the problems and methods of bacteriological control now in use.

The field of general bacteriology was represented by several papers. One dealing with the water content of spores and vegetative cells aroused considerable interest and discussion, it being pointed out in the paper that no differences in the water content of spores and vegetative cells was found, and so this is not the true explanation for the difference in heat resistance between the two forms.

Various phases of industrial bacteriology were presented in papers dealing with alcohol production of yeasts, germicidal action of chlorine compounds and studies on metabolism of bacteria under controlled conditions.

The field of virus research was represented by three reports of studies on poliomyelitis and one paper on Rocky Mountain spotted fever with reference to the Weil-Felix reaction. The reports on poliomyelitis dealt with the chemoprophylaxis of poliomyelitis, the immunological relationships of the virus isolated in the recent Los Angeles epidemic and the relationship of nasal and humoral antipoliomyelitic substances. The prevention of poliomyelitis in susceptible monkeys can be most effectively carried out with a one per cent. picric acid solution installed intranasally over a period of a few days prior to the intranasal instillation of the virus. The refractory state of the nasal mucosa seems to persist for quite a few days after the application of the picric acid. The exact duration of the refractory state has not as yet been accurately determined.

Several papers were read by title at the end of the program due to lack of time for their presentation.

SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

(Report by Earl R. Norris)

The Pacific Coast Branch and the Southern California Branch met on Wednesday morning and afternoon. Owing to the absence of officers of either section, Dr. E. R. Norris, of the University of Washington, presided at the first session, and Dr. Ira H. Manville, of the University of Oregon Medical School, at the second session.

The sessions were opened with a paper by Ira H. Manville showing the sparing action of pectin on the mucin of the mucous membranes of the alimentary tract and the gall bladder, owing to the use of its galacturonic acid in detoxification during menthol intoxication. Hazel E. Field, Robert P. O'Neal and L. Reed Brantley gave results showing the effect of cigarette smoking on blood sugar, blood chlorides and blood pressure and suggested that smoking has an influence on the endocrine system. James F. Reinhart, Louis D. Greenberg and Amos U. Christie gave a preliminary report of the ascorbic acid content of blood plasma in rheumatic fever, and J. F. Reinhart, L. D. Greenberg and Frances Baker of the ascorbic acid content of blood plasma in rheumatoid arthritis.

They suggest that ascorbic acid blood levels below 0.7 mg. per 100 cc are probably subnormal; in both conditions mentioned above lower values were found. A simplified respiration apparatus for work with small animals was described by M. Kleiber, who also reported, with H. Goss, on the fasting catabolism of phosphorus deficient rats. A. J. Lehman reported the preparation of extracts of urine and tissue having a marked effect upon blood pressure. Victor E. Hall read a paper on the influence of cold on the metabolic action of dinitrophenol, indicating that dinitrophenol interferes with the temperature-regulating mechanism. In reporting a genetic study of pubescent age in albino rats, Calvin P. Stone showed how rats by selection might be differentiated into two groups having a tendency to early and late maturing. O. Larsell had a number of photographs and diagrams illustrating the effect on the central nervous system of experimental limb amputation in foetal mammals; the amputations in the foetal stages were made possible by the use of marsupials. D. Warner, C. J. Robinson and Mildred Ellis read a paper on the results of long-continued asparin feeding to rats.

Five other papers were reported by title only.

WESTERN SOCIETY OF SOIL SCIENCE

(Report by S. C. Vandecaveye)

Four half-day sessions, two of these jointly with the Western Section of the American Society of Plant Physiologists, were held with an attendance ranging from 25 to 70. In a session devoted to soil morphology and classification, studies were presented on the morphological and chemical characteristics of certain soils, the physical properties and the management of the soil, and the economic approach as factors in soil classification and rating. Of particular interest was a paper by C. C. Nikiforoff pointing out that the coastal province, due to the Cascades, forms an independent physiographic unit in which the inversion of the horizontal soil zones does not show any marked vertical zonality. The morphological characteristics of the major soil groups in western Washington were further pointed out and discussed in the course of a full day field trip attended by 22 members.

A report of studies carried on at the University of California indicated that certain soils are capable of fixing soluble potassium in non-replaceable form. Tomatoes and barley were found to be able to absorb nearly all this fixed potassium in some of these soils but not in others. The anomalous behavior of magnesium in electrodialysis of soil colloids was reported from the State College of Washington. While exchangeable magnesium, like other exchangeable alkaline earth cations, is completely removable by extraction with neutral salts, it was not capable of complete removal from the exchange complex by electrodialysis.

The possible seriousness of spray residue accumulations in irrigated orchard soils was pointed out in two papers resulting from studies carried on at the Oregon State College and the State College of Washington, respectively. Lead arsenate spray accumulations seem to be confined largely to the cultivated surface layer of soil. Toxic effects on barley were found to be roughly in proportion to the concentration of the water soluble arsenic in the soil. Trees and their fruits appeared to be capable of assimilating both lead and arsenic. Barley tops absorbed appreciable quantities of arsenic but only traces of lead, while the roots absorbed large amounts of both.

Interesting results of studies on soil organic matter transformation, carried on by the University of Arizona and the State College of Washington, were presented and showed in general that the soil type, the nature of the organic residue, the temperature and the moisture affect the rate of decomposition and the nature of the soil flora. From work done at the University of Idaho it was shown that the addition of available phosphorus to calcareous soils produced a definite increase in the phosphorus and protein content of alfalfa. In a study of 30 non-irrigated orchard soils at the Oregon State College it was found that a favorable top soil is not sufficient to assure good tree growth without irrigation. In heavy soils much of the moisture classed as usable may never be used, because neither the roots can get to the moist soil nor can the moisture move to the roots.

The following officers were elected for the ensuing year: *President,* P. L. Hibbard, University of California, Berkeley; *Vice-president,* Robert Gardner, Colorado State College, Fort Collins, Colorado; *Secretary-treasurer,* S. C. Vandecaveye, State College of Washington, Pullman, Washington.

OBITUARY

HIRAM DRYER McCASKEY

FOR the second time within the year it has been our sad duty to pen an obituary notice of one who has devoted a part of his life and energies to the arduous and often dangerous work in our Far Eastern tropical dependency, the Philippines. Hiram Dryer McCaskey, who died recently at his estate, Boh Da Orchards, near Central Point, Oregon, had not been active in geological or mining work for several years. His most recent work had been done in connection with the U. S. Geological Survey in charge of the metallic mineral resources section. In his earlier years he served as the

second chief of the Philippine Mining Bureau in Manila. As Colonel Burrett, the first chief, was a lawyer and officer in the U. S. Volunteers, Mr. McCaskey was the first technical man to take over the work relinquished by the Spaniards, Abella y Caseriego and Centeno. Although a mining engineer, McCaskey had a keen interest in, and appreciation of, geological investigations in their relations to mining. This writer acknowledges with especial gratitude the debt he owes to his first chief in that difficult field when as a youngster he first faced the unusual task of unraveling the problems of Malayan geology.

In addition to his technical knowledge, Mr. McCaskey was possessed of true culture, gentleness of spirit, which even the most hard-boiled prospector appreciated. Although the son of a famous general of the U. S. forces in the Philippine Islands, McCaskey was essentially a man of peace and scholarly inclinations. These qualities early endeared him to the Filipinos, still chafing under the unavoidable irritations attendant upon the régime of the "Days of the Empire." He and others like him did a tremendous lot in making easy the difficult transition to civil government.

Although Mr. McCaskey's own published writings in the Philippine field were not numerous his great contribution was in making the work of his men as easy and effective as possible under pioneering conditions. He was always more than generous in giving full credit to others.

In spite of the disability which forced him to leave his Philippine labors in 1906, he rendered many years of effective service to the U. S. Geological Survey in Washington.

It was with keen sorrow that this "Old Timer" received word of the passing in southern Oregon of his former "Jefe de Minas," a very fine gentleman.

WARREN D. SMITH

UNIVERSITY OF OREGON

RECENT DEATHS

THE death at the age of seventy years has been announced of Dr. Charles Hamilton Ashton, professor of mathematics at the University of Kansas since 1903.

DR. ALFRED A. TITSWORTH, since 1886 a member of the faculty of Rutgers University, for forty-two years as professor of mathematics, died on August 15 at the age of eighty-three years.

DR. RICHARD OLDING BEARD, professor emeritus of physiology at the University of Minnesota, died on August 14. He was seventy-nine years old.

DR. FLORENCE FENWICK died on July 11 at the age of forty-two years. She received her doctor's degree at the University of Michigan in 1922 and was research fellow at Yale University from 1923 to 1928, since which time she has been physical chemist in the Research Laboratory of the U. S. Steel Corporation.

A CORRESPONDENT writes: "Dr. Julia Trueman Colpitts, associate professor of mathematics at Iowa State College, died at Southampton on August 8. She was returning from a visit to Europe, during which she had attended the International Congress of Mathematicians. Miss Colpitts was born at Pointe de Bute, N. B., received degrees at Mt. Allison University and Cornell University, and also studied at Columbia University and the University of Chicago. She had been a member of the faculty of Iowa State College since 1900. A member of Sigma Xi, Phi Kappa Phi and Sigma Delta Epsilon, Miss Colpitts had been national president of the latter organizaion. She had also been chairman of the Iowa Section of the Mathematical Association of America."

THE sudden death is announced of Dr. Frederick John Freshwater Shaw, director of the Imperial Institute of Agricultural Research, Government of India.

SCIENTIFIC EVENTS

A RADIO RESEARCH BOARD FOR INDIA

IT is stated in *Current Science,* edited at Bangalore, India, by Professor C. R. Narayan Rao, that, at the invitation of Professor S. K. Mitra, a number of distinguished investigators, including representatives of radio research workers from Australia and Canada, met recently in London to consider the question of forming a Radio Research Board for India. Professor Mitra, who was in England to acquaint himself with the latest developments in radio research, in the course of his speech emphasized the need for a coordinate organization with adequate funds at its disposal for conducting radio investigation in India. He said: "There are men available for such work in the universities, men who by their training are particularly gifted for such type of work. But without the cooperation of government departments, like the Air Ministry, the Meteorological and the Postal Departments, the universities, where alone such work is now being carried on, can not successfully conduct such investigations. The nature of the most helpful cooperation that is necessary is best exemplified by the British Radio Research Board, which maintains a close touch between the various government departments and the universities." Professor E. V. Appleton, King's College, London, supported the need for a board of the type envisaged by Professor Mitra. Sir Frank E. Smith mentioned that various problems such

as that associated with the field strength of received signals at different times of the day and at different seasons of the year with different wave-lengths and with different transmitting aerials, are of a local nature, which can be solved by work in the country desiring the information. If the research board is founded in India, it will be of help, not only to India, but to the international research work now being conducted in Great Britain and other countries. The British Radio Research Board will be glad to cooperate with any research organization which might be established in India. Professor A. S. Eve (Canada) and Professor T. H. Laby (Australia) also emphasized the need for the formation of such a board to bring engineers and physicists together in solving both theoretical and practical problems.

SALE OF NEWTONIANA

IT is reported in *Nature* that as a result of the sale of the Newton Papers, and other articles of interest in connection with Sir Isaac Newton, by Messrs. Sotheby and Company, on July 13 and 14, two gifts of scientific importance have now been made possible, and are worthy of record.

That portion of the papers which deal with Newton's work as warden, and afterwards master, of the Royal Mint, is bound in three folio volumes and contains 529 pieces. These were sold for £1,400 to Mr. Gabriel Wells, who placed them at the disposal of Lord Wakefield at cost, on the understanding that they would be presented to the nation. Lord Wakefield has presented them to the Royal Mint, where they will be available for inspection.

The very valuable and unique collection of Newtoniana already in the possession of the Royal Society has been enhanced by a gift from Sir Robert Hadfield which he purchased at the same sale. The gift comprises the following letters: four from Edmund Halley to Newton: four from Edmund Halley to Thomas Molyneux; two from Fontenelle to Newton; one from Philip Naudé to Newton; and one from Brook Taylor to Newton.

A portrait of Sir Isaac Newton, painted in 1702 by Sir Godfrey Kneller (the most famous of the Newton portraits), has been purchased by the trustees of the National Portrait Gallery (with a contribution of half from the National Art-Collections Fund) from Messrs. Rosenbach, of New York. The portrait was actually sold at the same sale for £800, but through the generosity of Dr. Philip Rosenbach was resold to the trustees of the gallery at cost price.

Among the many other items of interest in connection with Newton disposed of at the sale were the following: nine letters to Newton from Edmund Halley, containing the history of the publication of the "Principia" (£310); a notebook in Newton's own handwriting, giving an interesting and amusing list of expenses, and, at the other end, various problems in geometry and conic sections (£180); an autographed draft of about 1,000 words of a very important statement on the invention of the calculus (£210).

THE SCHOOL OF ENGINEERING PRACTICE OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE appointment of new directors at the three field stations of the School of Chemical Engineering Practice of the Massachusetts Institute of Technology has been announced by Professor Walter G. Whitman, head of the department of chemical engineering. The appointments come as a result of the resignations of Professor Frederick W. Adams, director of the Boston Station; Charles M. Cooper, of the Bangor Station, and Robert L. Hershey, of the Buffalo Station, who have accepted industrial positions. Professor Adams has been appointed senior incumbent in a multiple fellowship established by the Pittsburgh Plate Glass Company at the Mellon Institute. He will direct the research activities of a group working on problems in the glass industry. Professors Cooper and Hershey have joined the staff of E. I. du Pont de Nemours and Company.

Directors of the stations have been appointed as follows: The Boston Station, Dr. Robert C. Gunness, a graduate of the Massachusetts State College in 1932; the Bangor Station, Howard S. Gardner, Jr., Massachusetts Institute of Technology, '31, chemical engineer of the Eastman Kodak Company; the Buffalo Station, Dr. John E. Eberhardt, C.E., Cincinnati, '33, assistant director of the station from 1934 to 1935, this year instructor in the department of chemical engineering at the Massachusetts Institute.

The assistant directors at the three stations will be Henry J. Ogorzaly, of Yonkers, N. Y., at the Boston Station; Roy P. Whitney, of Milo, Maine, at the Bangor Station, and George A. Akin, of Princeton, Ky., and Charles W. Smith, of Abington, Mass., at the Buffalo Station. All are graduates of the School of Chemical Engineering Practice.

THE LEVERHULME SCHOLARSHIPS IN GREAT BRITAIN

THE Advisory Committee on the awards for 1936 of Leverhulme Research Fellowships and grants in aid of research has made twenty-one nominations to fellowships and ten grants in aid of research, tenable for varying periods up to two years.

The names of the fellows in the sciences and the subjects of the researches are as follows:

MRS. A. ARBER, M.A., Camb., D.Sc., Lond., fellow of

University College, London. Studies in the principles of angiospermous morphology and in the history of botany.

S. J. DULY, M.A., Camb., head of department for the scientific study of commercial products, City of London College. The carriage of goods by sea.

F. FAIRBROTHER, D.Sc., Manc., senior lecturer in chemistry, Manchester University. The study of electrolytic dissociation process and the mechanism of chemical reactions by the use of induced radioactivity.

C. P. FITZGERALD, author. Sociology of the non-Chinese tribes of Yunnan, S. W. China.

S. D. GARRETT, B.A., Camb., formerly assistant plant pathologist, Waite Agricultural Research Institute, University of Adelaide, South Australia. The biological antagonism of the soil microflora towards root disease fungi or crop plants. (Renewal of present fellowship.)

J. DE GRAAF HUNTER, F.R.S., C.I.E., M.A., Sc.D., Camb., late director, Survey of India. Planning and execution of geodetic triangulation of great extent.

MRS. K. LONSDALE, D.Sc., Lond., research worker, Royal Institution, London. Relation between structure and physical properties of organic molecules. (Renewal of present fellowship.)

E. P. MUMFORD, M.Sc., Manc., M.A., Cardiff, late director, Pacific Entomological Survey, Honolulu. Terrestrial and fresh-water biota of the Marquesas Islands. (Renewal of present fellowship.)

F. R. PERRY, M.Sc., Manc., member of research department, Metropolitan-Vickers Electrical Co., Ltd., Manchester. Study of overvoltages due to lightning on transmission lines. (Renewal of present fellowship.)

A. L. REIMANN, Ph.D., Berlin, D.Sc., Adelaide, research physicist, General Electric Company, Ltd., Wembley, Middlesex. Electronic conduction phenomena in solid insulators and semi-conductors.

W. E. WILLIAMS, D.Sc., Lond., M.Sc., Manc., lecturer in physics, King's College, London. The determination of the vacuum wave-lengths and the structures of spectral lines by means of his reflection echelon.

Grants in aid of research have been made to the following:

A. E. BOYCOTT, F.R.S., M.A., D.M., D.Sc., Oxon., late Graham professor of pathology, University of London. The oecology and genetics of British non-marine mollusca.

H. J. FLEURE, F.R.S., M.A., Mach., D.Sc., Wales, professor of geography, Manchester University. Physical (racial) characteristics of the peoples of Wales.

J. W. HESLOP HARRISON, F.R.S., D.Sc., Durham, professor of botany, Armstrong College, Newcastle-on-Tyne. Researches on evolution and heredity. (Renewal of present grant.

T. N. HOBLYN, statistician, East Malling Research Station, Kent. A study of technical problems in the layout and conduct of horticultural field experiments under tropical and sub-tropical conditions.

W. H. PEARSALL, D.Sc., Manc., reader in botany, University of Leeds. The growth of algae.

O. W. RICHARDS, M.A., D.Sc., Oxon., lecturer in entomology, Imperial College of Science and Technology, London. The study of the habits of South American bees and wasps.

C. W. VALENTINE, M.A., Lond., D.Phil., St. Andrews, professor of education, Birmingham University. The psychology of early childhood.

The following has been awarded a Leverhulme Traveling Fellowship:

A. RUSCOE CLARKE, M.B., Lond., F.R.C.S., Eng., on nomination of the Medical Research Council.

STANDARD BRANDS FELLOWSHIPS

STANDARD BRANDS, INCORPORATED, producers of Fleischmann's Yeast, Chase and Sanborn's Dated Coffee and other products, has distributed ten annual fellowships among investigators in American universities. Six of the awards have been made to enable the continuance of previous fellowship work. Four recipients were granted awards for the first time. These fellows are undertaking specialized research along the following lines:

Dr. R. O. Bengis is continuing his work at Yale University, on the chemistry of coffee and the changes that take place when coffee grows stale.

Dr. Olaf Bergeim, at the University of Illinois, Chicago, is making a study of yeast vitamins set free in the intestinal tract and their utilization in the human system.

Dr. Virginia Fisher is collaborating this year with Dr. Lloyd Arnold at the University of Illinois, where they are making a complete survey of fungi normally occurring in or on the human body.

Dr. Walter H. Eddy, of Columbia University, New York City, is proceeding with his work on the isolation of vitamin B from yeast.

Dr. R. H. Cheney is working at Long Island University, Brooklyn, on the physiological action of fresh and stale coffee and caffeine.

Dr. R. J. Williams, at the University of Oregon, is investigating pantothenic acid, the growth stimulant that he discovered.

Dr. U. Lash Miller and his colleagues are extending their research on yeast bios at the University of Toronto.

Dr. S. I. Bechdel, at Pennsylvania State College, is engaged in studying the use of irradiated dry yeast for treating rickets in calves.

Dr. John A. Killian, at the Killian Research Laboratories, New York City, is undertaking research on the value of bread in the diet.

ARTHUR A. NOYES

DR. ROBERT A. MILLIKAN, chairman of the executive council of the California Institute of Technology, concluded his commencement address with the following words concerning Arthur A. Noyes:

The last great act of his life was altogether typical of the man. Two months ago he asked me to come over

to his sick room, and said, "The next great step in the development of the California Institute is to get Max Mason, who has resigned his position as president of the Rockefeller Foundation, to come out here and join the staff of the California Institute of Technology as vice-chairman of the Observatory Council to take over a large share of the responsibility of this enormous enterprise of the 200-inch telescope and some other related undertakings which the institute must assume. I understand full well the difficulties which we are having at present to keep our budget balanced. but I know a way to handle that situation. I am getting a larger salary than I need, and I want you to take what it costs to get Mason here out of my present income."

As a result of that act I may announce to-day that beginning next October Dr. Max Mason joins the permanent staff of the California Institute of Technology, and takes his place upon its Executive Council. All this in the face of the fact that Dr. Noyes's personal life-long devotion was to his chosen field of chemistry, the depth of that devotion and interest being attested by the fact that when we opened his will the day after his death we found that (save for some minor bequests) he had left all that he had, some $150,000, to the California Institute to be devoted exclusively to research work in pure chemistry by men who had already obtained the doctorate in chemistry or had received the equivalent training. Do you wonder that I feel that the atmosphere of mutual assistance and self-forgetting cooperation toward a great ideal which has been created here and which is to-day the most priceless asset of this institution is largely the legacy of the mind and the soul of Arthur A. Noyes? We can not pay the debt which we owe to him by any words of eulogy or praise. "It is rather for us to be here dedicated to the great task remaining before us," that the spirit and ideals and accomplishments of Arthur A. Noyes shall not perish from the earth.

SCIENTIFIC NOTES AND NEWS

THE honorary degree of the University of Paris was conferred on August 12 on Dr. George David Birkhoff, Perkins professor of mathematics and dean of the faculty of arts and sciences at Harvard University.

THE *Bulletin* of the American Mathematical Society calls attention to the fact that Professor Oskar Bolza, of the University of Freiburg, who taught for twelve years at the Johns Hopkins University, Clark University and the University of Chicago, took his doctor's degree at the University of Göttingen on June 28, 1886, fifty years ago. Congratulations were forwarded to him by the Deutsche Mathematiker-Vereinigung and the American Mathematical Society.

DR. HARRY H. LAUGHLIN, of the Carnegie Institution, Cold Spring Harbor, N. Y., was among those awarded an honorary doctorate in medicine on the occasion of the celebration of the five hundred and fiftieth anniversary of the University of Heidelberg.

THE University of Wales has conferred the honorary doctorate of science on Dr. A. A. Read, emeritus professor of metallurgy, University College, Cardiff.

ON the occasion of the retirement of M. Marcellin Boule as director of the Institute of Human Paleontology and professor of paleontology in the Museum of Natural History, Paris, a medal, the work of A. de Jaeger, will be presented to him by his colleagues and students.

DR. JEAN SABRAZÈS, professor of pathological anatomy and clinical microscopy in the University of Bordeaux, has been elected correspondent of the Section of Medicine and Surgery of the Paris Academy of Sciences, in succession to the late Professor Léon Frédericq.

WE learn from *Nature* that Dr. Emil Abderhalden, professor of physiology and director of the Physiological Institute of the University at Halle, has been elected an honorary member of the Society of Biological Chemists at Bangalore.

DR. W. R. DODSON, formerly dean of the College of Agriculture of the Louisiana State University and more recently connected with the Federal Experiment Station at Jeanerette, will join the faculty of the department of agronomy at the university. The honorary degree of doctor of science was conferred on Dr. Dodson at the commencement ceremonies on August 6, which brought to a close the summer session. In conferring the degree, President James M. Smith stated that it was given in recognition of his "forty years of service to the youth of the State of Louisiana as a teacher and leader in agriculture, as an organizer of the forces for the development of better agricultural conditions in the South, and for launching the movement that resulted in the establishment of the Louisiana State University on its present site."

PROFESSOR R. B. HARVEY, director of the Florida Citrus Research Laboratory at Dunedin, Fla., on sabbatical leave from the University of Minnesota for a year, has been elected president of the American Society of Plant Physiologists for the year 1936–37. Dr. O. F. Curtis, professor of plant physiology, Cornell University, Ithaca, has been elected vice-president.

DR. FRANK H. LAHEY, of Boston, was elected at the recent meeting in Chicago president-elect of the American Society for the Study of Goiter.

DR. MONROE E. FREEMAN, assistant professor of agricultural and biological chemistry in the University of Maine, has become research professor of chemistry

at the experiment station of the Massachusetts State College.

AT the University of Washington the following promotions in the department of physics have been made: From associate professor to professor, Dr. Henry L. Brakel; from assistant professor to associate professor, Joseph E. Henderson and Donald H. Loughridge; from associate to instructor, Llewellyn A. Sanderman.

DR. ARTHUR WORMALL has been appointed from October 1 to the university chair of biochemistry in the University of London, tenable at St. Bartholomew's Hospital Medical College. He has been since 1933 senior lecturer in biochemistry in the University of Leeds.

DR. CARL E. LADD, dean of the New York State College of Agriculture at Ithaca and head of the Governor's agricultural advisory committee, has been named chairman of the New York State Planning Board to succeed Provost A. R. Mann, who has resigned.

NEW staff members of the Truesdail Laboratories, Inc., Los Angeles, have been appointed as follows: Dr. C. E. P. Jeffreys, California Institute of Technology, will serve as research chemist and bacteriologist. Dr. Jeffreys, for the past two years, has been a research assistant in biochemistry under a grant from the Rockefeller Foundation for Medical Research. Miss Marion G. Sharp, a graduate student from the University of California at Berkeley, is to serve as nutritionist in charge of animal experimentation, and Irving G. Halpern, University of Southern California, as chemist.

DR. WILEY D. FORBUS, professor of pathology at the School of Medicine of Duke University, has been elected to serve on the National Board of Medical Examiners as chairman of the Division of Pathology. He succeeds as member of the board Dr. Howard T. Karsner, of the School of Medicine of Western Reserve University.

RESEARCH with pantothenic acid at Oregon State College will be carried out under the direction of Dr. Roger J. Williams under the provision of a three-year grant of $20,000 made by the Rockefeller Foundation. Dr. John H. Truesdail, for two years on the research staff of the du Pont rayon plant at Buffalo, N. Y., and Dr. Harry J. Weinstock, a graduate student at the University of Illinois, will assist Dr. Williams. One more staff member and two graduate assistants may be appointed later.

A GRANT has been awarded by the Committee on Scientific Research of the American Medical Association to Professor Carl A. Dragstedt, of the Northwestern University Medical School, for a continuation of his work on experimental anaphylaxis.

DR. W. H. CAMP, of the New York Botanical Garden, has returned after spending two months of field study and collecting in the southern Appalachians, principally in the Blue Ridge of Virginia and the Great Smoky Mountains of Tennessee. His collections include more than 4,000 specimens.

DELEGATES from three more nations have been appointed to attend the World Power Conference to be held in Washington from September 7 to 12, bringing the number of nations participating to fifty. These are: R. J. Harvey, consulting engineer, from New Zealand; Luis Schlesinger Carrera, engineer, from Guatemala, and Wouter Cool, general secretary of the Royal Institution of Engineers, from the Netherlands East Indies.

THE third International Congress for Study of Light will be held in Wiesbaden, from September 1 to 7, under the presidency of Dr. W. Friedrich, Berlin.

THE fifteenth International Congress for Hydrology, Climatology and Medical Geology will be held at Belgrade, from September 25 to 29.

THE International Seed Testing Congress, which met this year at Stockholm, has accepted an invitation to hold the seventh congress in Washington, D. C., in 1937.

THE Omaha Section of the American Chemical Society announces that it will sponsor the next (fourteenth) Midwest regional meeting of the society. Sessions will be held in Omaha from April 29 to May 1. It is expected that the meeting will be of interest to those chemists of the Middle West who will not find it possible to attend any of the next three national meetings of the society, which will convene in the East (Pittsburgh, Chapel Hill, N. C., and Rochester, N. Y.). Divisional sessions are being tentatively planned in agricultural chemistry, biochemistry, chemical education, industrial chemistry, organic chemistry and in physical and inorganic chemistry. Several symposia are planned, including one on "Eggs" sponsored by the agricultural division. Additional information may be obtained by writing to the general convention secretary, Dr. Nicholas Dietz, Jr., School of Medicine, Creighton University, Omaha.

THE Prime Minister of England has nominated the following official delegates to represent the government at the third World Power Conference and Second Congress of the International Commission on Large Dams of the World Power Conference to be held concurrently in Washington between September 7 and 12: Lord Falmouth, vice-president, Conjoint Conference

of Public Utility Associations; N. G. Gedye, British delegate to the International Commission on Large Dams of the World Power Conference; T. Hardie, director, Gas Light and Coke Company; J. M. Kennedy, electricity commissioner; Dr. F. M. Lea, senior scientific officer, Building Research Station, Department of Scientific and Industrial Research; C. H. Merz, member, British National Committee of the World Power Conference; Sir Archibald Page, chairman, Central Electricity Board; C. Rodgers, deputy director, British Electrical and Allied Manufacturers' Association; Dr. F. S. Sannatt, director of Fuel Research, Department of Scientific and Industrial Research; E. T. Williams, assistant director of Electrical Engineering, Admiralty. There are 64 British members of the conference and congress; including ladies who will accompany the members, the total British party will exceed 100.

AMONG bills passed in the final week of Congress was one awarding a medal to Lincoln Ellsworth for his work in the Antarctic. The bill includes the first official recognition of the area claimed there for the United States. The law authorizes the President "to present a gold medal of appropriate design, with accompanying distinctive ribbon, to Lincoln Ellsworth, noted American explorer and outstanding pioneer in exploratory aviation in the Arctic and in Antarctica, for claiming on behalf of the United States approximately 350,000 square miles of land in Antarctica between the 80th and 120th meridians west of Greenwich, representing the last unclaimed territory in the world, and for his exceptionally meritorious services to science and aeronautics in making a 2,500-mile aerial survey of the heart of Antarctica, thus paving the way for more detailed studies of geological, meteorological and geographical questions of world-wide importance and benefit."

THE electors of the professorship of social anthropology at the University of Oxford propose shortly to proceed to an election of a professor. Candidates are requested to send in their names, with eight copies of any statement, references and testimonials that they may think desirable to submit, so as to reach the registrar not later than September 19. A fellowship without emolument at All Souls College is tenable during the tenure of the professorship. The stipend of the professorship will be £1,200 a year. According to the university statutes the duties of every professor shall include "original work by the professor himself and the general supervision of research and advanced work in his subject and department. The professor shall reside within the university during six months at least in each academical year, between the first day of October and the ensuing first day of August, and shall lecture or hold classes in each term during that period. He shall give, or hold, not less than thirty-six lectures or classes, in each academical year, of which not less than twenty-eight shall be lectures. His lectures or classes shall extend over a period not less in any term than six weeks and not less in the whole than twenty weeks, and in two of the three terms he shall lecture or hold classes, at least twice a week in each of six weeks."

ACCORDING to *The Experiment Station Record*, the University of Maryland plans to establish an Institute of Transport. A collection of books on highway education now at the University of Michigan and an exhibit of road-making machinery and models have been contributed by their owner, Dr. Charles Henry Davis, who is also undertaking to raise through private sources a fund of $500,000 for a museum building which will serve temporarily as an administration building for the institute.

THE University of Cincinnati has received a gift that in five years will amount to $55,000 from Mrs. Louis Fleischman Yeiser to establish in the college of medicine the Craig Yeiser Memorial Fund in Preventive Medicine. She will give $10,000 a year for five years and an additional $5,000 for equipment to carry on research in preventive medicine in memory of her son who died in 1935 of pneumonia.

AN enlarged laboratory named in honor of Professor G. E. Stone, of the Massachusetts State College, was dedicated in Stamford, Conn., on July 20, at the sixth scientific meeting of the Bartlett Tree Research Institute. Dr. Stone, who was a pioneer in shade tree research in this country, was present to reply to Dr. E. P. Felt's address of dedication. The day's program included talks and discussions on the care and protection of shade trees, followed by a clam-bake in the evening.

ACCORDING to the *Journal* of the American Medical Association the U. S. Patent Office has recently issued to the Wisconsin Alumni Research Foundation two patents on the isolation and purification of the gonadotropic hormones of the anterior pituitary gland. These patents were on the application of Frederick L. Hisaw, Ph.D., and Harry L. Fevold, Ph.D., Madison, and were assigned by them to the Wisconsin Alumni Research Foundation. The foundation announces that although it contributed in part to the development of this research through grants in aid, it will administer these patents in a way designed to benefit the public without thought of any financial return other than that required to safeguard and control proper use of the products. Under these conditions Dr. Hisaw and Dr. Fevold will not receive any pecuniary reward for their discoveries.

DISCUSSION

UNDERTOW, RIP TIDE OR "RIP CURRENT"

THE outworn dogmas of science seem to be particularly concentrated in the discussions of the ocean and geology books. In a previous note the writer called attention to several of these fallacies.[1] Among them would have been included the so-called "undertow." The common conception of the undertow, which comes evidently from panicky surf bathers, but has been commonly accepted, is that water is carried in along the surface by the waves or the wind and returns underneath, developing a current which may be strong enough locally to carry people under and out to sea. In 1925 Davis[2] challenged this idea, pointing out quite correctly that a wave causes the water to surge forward at the crest and backward in the trough both at the surface and on the bottom so that a person in the surf is alternately carried forward and backward. He suggested, however, that there must be a subsurface return of the water pushed into a pocket beach by an onshore wind. Davis requested others to write of their experiences which might bear on the subject. The series of short notes which followed must have left readers undecided as to what they should believe. Three writers[3] described currents which they had experienced which carried them seaward faster than they could swim toward land, although the current was largely a surface phenomenon. Another writer on the basis of observations agreed with Davis that the undertow was mythical, while still another gave theoretical support for the old conception. On the other hand, measurement by U. S. Army engineers[4] of the movement of water along the bottom outside the beach showed that the water moves in and out along the bottom in the manner described by Davis. It comes in with a strong, quick surge and goes out with a long, slower movement.

The present writer first obtained some light on the question through conversations with Mr. Cecil Nichols, head of the Los Angeles life-guards. Mr. Nichols told of what he called "rip-tides" along the beach at Venice, California, which he said frequently carried out bathers beyond their depth. Examination of these "rip-tides" showed that they are narrow bands of water moving outward almost at right angles to shore along straight stretches of beach. They are spaced at distances of 200 yards or more and extend out for distances up to half a mile. These currents were observed both under conditions of calm and with an onshore wind. They could be distinguished easily because of the zones of roiled water and foam which were moving out and interfering to some extent with the incoming breakers. These currents proved to be of rather short duration, lasting several minutes as a rule and redeveloping either at the same or in a different location.

By swimming in the "rip-tides" it was found that they have at least some velocity at the bottom as well as that which is so observable at the surface. In one case the bottom was found to contain a depression about a foot in depth along the axis of a persistent "rip-tide." In the outer portion of the current an eddying motion was found. The terminus of the "rip-tide" as well as its marginal boundaries were seen from a row-boat to be very distinct both because of the moving water and because of the suspended sediment in the water.

"Rip current": The name "rip tide" is certainly not appropriate, since the current described has nothing to do with the tide. It may be unwise to suggest another name to replace this one, which has some usage in different parts of the country. Certainly the practice of making new names causes much unnecessary confusion. However, this case seems to merit a change and the name "rip current" is suggested, since it is close to the other name and describes the way in which the current rips through the oncoming breakers.

Since studying the "rip currents" at Venice, California, the writer has seen the same phenomenon in many other places along the west coast as well as in the Hawaiian Islands and along the east coast. Most of these observed cases were off relatively straight beaches and in several cases close to piers. It seems certain that the outward moving currents described by the contributors referred to previously fall into the same category. Also conversations with life-guards from various parts of the coast have shown that the outward moving currents are not unusual. It can scarcely be doubted that some reports of undertow are based on "rip currents," although probably in other cases, as Davis suggested, the suction of the returning wave may have led to the belief in undertow.

Probable cause: The cause of the "rip currents" seems to be essentially that described by Hite,[5] that is, the waves of oscillation changing into waves of translation upon approaching the coast and tending to pile up the water on the shore. Most of this water returns with the outgoing wave, but it appears that some of the water is concentrated into zones and develops an outward current which persists far longer than the return movement of the individual waves. How much this return current is conditioned on the development of an outer bar as described by Hite

[1] SCIENCE, 78: 406–408, 1933.
[2] W. M. Davis, SCIENCE, 61: 206, 1925.
[3] W. C. Jones, SCIENCE, 61: 444, 1925; Wallace Craig, Brant, M. P. Hite and W. M. Davis, SCIENCE, 62: 30–, 1925; T. T. Quirke, SCIENCE, 61: 468, 1925.
[4] Captain L. H. Hewitt, personal communication.
[5] M. P. Hite, *op. cit.*, p. 32.

was not ascertained, but this outer bar probably does play an important part.

Geological importance: The "rip-currents" must be an important factor in the transportation of fine sediment out from the beach, since they are observed to have considerable sediment suspended in them. Probably they are one of several causes for the well-sorted condition of many beach sands.

F. P. SHEPARD

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A HYPOTHESIS TO EXPLAIN BROWN ROOT-ROT OF HAVANA SEED TOBACCO

Two types of root-rot are known to affect Havana seed tobacco grown in the Connecticut Valley. Black root-rot is caused by the fungus *Thielavia basicola* (Berk. and Br.) Zopf. The conditions under which it develops are understood, and practicable methods for its control in the field are known. On the contrary, little is known about the cause and nature of brown root-rot, the other type. No causal organism has been demonstrated to be associated with it. It has puzzled plant pathologists and agronomists for years. Brown root-rot produces brown lesions on the roots, causes malformation, stunting and decay of the roots, dwarfing of the plant, spindly growth and low yields.

Within the past several years, while at the Massachusetts Agricultural Experiment Station, the writer and his associates conducted researches which bore directly or indirectly on the cause and nature of brown root-rot of tobacco. The results are here briefly summarized and a hypothesis is presented for the possible benefit of those interested in the subject.

(1) In unsterilized water cultures, ammonium compounds, amino acids and certain amides were toxic to tobacco plants and caused symptoms very similar to those of plants affected by brown root-rot in the field. In sterilized media containing these forms of nitrogen growth was slow, but the roots were not injured. These experiments indicated that the browning and rotting of the roots in unsterilized media was a secondary effect caused by common decay organisms. Comparative experiments with several other crop plants showed that tobacco is one of the more sensitive crop plants to toxicity of unoxidized forms of nitrogen.

(2) The most highly oxidized form of nitrogen, namely, nitrate, was most readily and completely assimilated by tobacco, if the plant was grown to maturity. Neither brown nor decaying roots nor other symptoms of brown root-rot resulted from the use of nitrate nitrogen, except in the latter growth stages when ammonium nitrate was used. In the early growth stages ammonium nitrogen from any source caused more rapid growth than did nitrate nitrogen, and there were no apparent ill effects, but in the later stages ammonium nitrogen caused decay of the roots, even when used in low concentrations. When plants with diseased roots were transferred from ammoniacal solutions to nitrate solutions, they recovered, and new healthy roots were produced.

(3) Chemical analysis of tobacco plants grown in water cultures containing ammonium and nitrate nitrogen, respectively, showed considerably higher percentages of nitrogen in tops and roots of plants supplied with ammonium nitrogen. The tops of field-grown plants which showed symptoms of brown root-rot were found to contain more total nitrogen than did normal field plants, but litle or no difference was found in the nitrogen content of the roots of the same plants. However, it was impossible to get a fair sample of affected roots due to obvious inherent difficulties.

(4) Appreciable quantities of ammonia were found in tobacco field soils in the early part of the growing season. Little difference, however, was found between soils whose crops were affected and those which were not affected by brown root-rot. This may be explained by a possible rapid, preferential absorption of ammonia by the young plants.

(5) Soil amendments which were found in some cases to reduce or eliminate brown root-rot of tobacco grown in infested soil were peat and mono-calcium phosphate, both of which will absorb or inactivate ammonia to some extent. Sodium and calcium nitrate when added to infested soil, did not materially reduce brown root-rot. The tobacco was grown in a soil having a pH of about 5.0, and in a soil of this reaction a preferential absorption of ammonia is to be expected. In such a strongly acid soil nitrate nitrogen would probably be absorbed in only small amounts even if present in large quantities, so long as ammonium and other basic forms of nitrogen were present. The addition of lime did not reduce brown root-rot infection, except in the latter part of the growing season and its ameliorating action was thought to be due to its enhancement of the nitrification process.

(6) Brown root-rot of field tobacco was observed to be worst in the early part of the growing season. It decreased in the latter part of July, when nitrification was found to be at its peak. Fields with mild or moderate infestation of brown root-rot often improved considerably or entirely recovered during the latter part of the growing season if conditions for nitrification were favorable. The disease was worst in cool wet seasons, when conditions for nitrification were least favorable.

(7) Brown root-rot could not be transferred from one soil to another by inoculation with small amounts of infested soil, either in the greenhouse or in the field. It was reduced or eliminated by drying infested soil in the air, either at room or higher temperature.

(8) The disease was observed to be worst follow-

certain crops grown in the same field, particularly corn and timothy sod. It rarely occurred in continuous culture of tobacco, and fields strongly infested with brown root-rot usually recovered after one or two years of tobacco culture. It is thought that the rate of decomposition and nitrification of crop residues is an important factor governing the occurrence of the disease. Its ephemeral character under certain conditions is well established.

Because of the facts presented under 1, 2, 3, 4 and 5, it seems that the unoxidized forms of nitrogen resulting from the decomposition of organic matter are indirectly the cause of brown root-rot. Secondly, because of its ephemeral and transitory character and its relation to the cropping system, as shown under 6, 7, and 8, it appears that the unoxidized form or forms of nitrogen concerned originate from plant residues and possibly, also, from organic nitrogenous fertilizers supplied in large quantities in tobacco culture. Finally, it appears that the rotting of the roots is due to the comparatively high concentration of nitrogen in the roots, or a narrowed carbon-nitrogen ratio, caused by rapid absorption of basic nitrogen. The basic forms of nitrogen are not in themselves toxic in the concentrations usually found in the soil, but produce a condition in the roots which makes them easy prey to decay organisms commonly present in the soil. This explanation of the cause and nature of brown root-rot is presented as a working hypothesis, awaiting further work for its substantiation or disproval.

A. B. BEAUMONT

NAMES OF AND SYMBOLS FOR THE ARTIFICIALLY RADIOACTIVE ELEMENTS

THE system of naming the artificially radioactive elements, and especially the symbols used for these names, have apparently been adapted from the systematic naming of the naturally radioactive elements which follow radon in the radium family. Due to the number of elements known to be artificially radioactive, a possibility of ambiguity in the symbols has arisen. The symbols for radium F and for radiofluorine are Ra F and RaF; the symbol for radiosulfur and the formula of the compound radium sulfide are both RaS. The first pair of symbols is similar; in the second case, the symbol of an element and the formula of a compound are identical. In the event of a compound composed of two or more artificially radioactive elements, the formula may become very confusing: radiophosphorus radiotriiodide, $RaPRaI_3$, is an example. This could readily be confused with the formula of a molecular compound.

The systematic naming of the later members of the radium family is quite distinct from the naming of the artificially radioactive elements: the first are radium A, etc., the second, radiophosphorus, etc. One is a member of the radium family of elements; the other is not. To emphasize this difference, it is proposed that the artificially radioactive elements be named in such a way that the element is considered to be of primary importance, and the radioactivity secondary: the radioactivity is indicated by the hyphenated italicized prefix *radio-*; *e.g.*, *radio*-phosphorus. This nomenclature is entirely analogous to that of isomeric organic compounds, such as *para*-nitrophenol, and the emphasis is placed on the element rather than on one of its attributes. The symbol *ra*-P contains only one capital letter, and so can not lead to the confusion now possible in chemical formulae. The symbols mentioned in the first paragraph would become Ra F and *ra*-F, *ra*-S and RaS, and *ra*-P-*ra*-I_3. The subscript and superscript now used for the atomic number and the atomic weight may be included in the usual manner. No confusion is anticipated between the symbol *ra-* for *radio-* and the *r-* (or occasionally *ra-*) which is sometimes used for racemic compounds.

GERALD M. PETTY

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THE WEATHERING OF FLINT ARTIFACTS

I WANT to get some information about the weathering or patination of flint flakes and artifacts. Under the direction of the Smithsonian Institution Dr. A. R. Kelly has been doing a systematic study of the Indian mounds so numerous in the vicinity of Macon, Georgia. This is said to be the largest enterprise of the kind in the eastern United States, employing several hundred men for nearly two years. I had noted in a deep trench cut through at least four former levels of Indian civilization that there was an increasing amount of patination of the flints at the lower horizons. The study of several lots of 250 to 1,000 artifacts taken from this and other places of study seems to reveal an *average* definite increase for apparent age. The larger number, perhaps all, of these flints are derived from the near-by residuum of the Ocala limestone, one of the local upper members of the Eocene period. This limestone is associated with the unconsolidated sediments of the Coastal Plain, which have not been subjected to metamorphism.

The amount of patination found varies from zero to more than four millimeters, and the effects are found in all types of flints. The more attractive jaspers are undoubtedly affected by actinic rays, but a loosening of their silicic binding material occasionally exceeds the bleaching. Information from Dana, Merrill and others throws little light on the subject. Eoliths from Kent, England, show a different type of patination, which would prove to be affected easily by frost and other weathering factors.

No flints secured from localities of metamorphic

rocks have been observed which had any such effects. Cyrus N. Ray records such patination in finds about Abilene, Texas, and Dr. A. H. Godbey read a paper before the Society for American Archeology, indicating similar observations. Both of these could have been accessible to flints derived from Coastal Plains deposits.

After a study of several thousand artifacts, we believe we are upon the track of a yard-stick for the dating of several Indian civilizations in the Southern United States, but I doubt the validity of the same set scale for other locations. The existence of Folsom man in Georgia seems very probable, though the data in Minnesota and New Mexico apparently give a much longer time than seems indicated at Macon and at other places in this vicinity. We set a provisional date of 6,500 years, but await further study to claim this, and it may be exceeded.

I ask information bearing on the matter of weathered or patinated flints in America and their probable source. The weathering of quartz and obsidian arrows does not seem to be related to that of the flints from the Coastal Plain.

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SPECIAL ARTICLES

ELECTRIC IMPEDANCE AND PERMEABILITY OF LIVING CELLS

OWING to the lack of agreement between recent papers on the electrical impedance of living cells it seems pertinent to indicate the value of the Wheatstone bridge and centrifuge in analyzing impedance. I took a university course in radio engineering and spent seven years in improving a Wheatstone bridge for high frequency currents.[1] It was shown by Richardson[2] that there is no "skin effect" in electrolytic conductors up to 8 megacycles.

A living cell is not merely a spherical drop of electrolyte solution, but the surface layer has a greater impedance than the interior. It is therefore difficult to apply Clerk Maxwell's formula for the electrical resistance of a suspension of spheres to a suspension of living cells. It simplifies the problem to centrifuge down the cells until they touch one another. I showed that erythrocytes may be centrifuged down in 6 minutes at 20,000 revolutions per minute,[3] and recently that the cells of the thyroid gland may be centrifuged down at less than 100,000 revolutions per minute.[4]

In experiments on sea urchin eggs I found[5] that the electric impedance (resistance to an alternating current) of sea urchin eggs decreased on fertilization. In order to simplify the interpretation it was necessary before the first determination of impedance to wash off the glyco-protein jelly that surrounds the egg. The method used was that of quickly (to avoid lack of oxygen) packing the unfertilized eggs down by centrifugal force in the electrode vessel, marking a line at the upper border of the eggs, determining the impedance, dispersing the eggs in sea water of the same electric conductivity as that in which they had been before packing, but to which spermatozoa had been added, and after the necessary lapse of time quickly packing them down again to the same level and determining the impedance. In this way the total impedance was more nearly that of the eggs themselves and was little affected by the film of sea water between them. It was thus not necessary to use any formula for the ratio of eggs to sea water, since sea water was in a vanishingly small quantity. This work was confirmed by Gray,[6] but later denied by Cole[7] with the words, "No specific change has been found in the interior resistance or the surface impedance which can be related either to membrane formation or cell division." In later papers, however, Cole has come to the opposite conclusion. He finds that the impedance of the surface is *reduced* on fertilization. In a study on Hipponoë eggs[8] he states, "The membrane of the fertilized egg is practically non-conducting at low frequencies and shows a static capacity 2.5 times that of unfertilized egg." Since the impedance,

$$Z = \sqrt{R^2 + (2\pi fL - \frac{1}{2\pi fC})^2}$$

(where R = resistance, C = capacity, L = inductance and f = frequency), where C is increased the impedance is diminished. In a study of Arbacia eggs[9] Cole states: "The unfertilized egg has a static plasma membrane capacity of 0.73 $\mu f/cm^2$, which is practically independent of frequency. The fertilized egg has a static membrane capacity of 3.1 $\mu f/cm^2$ at low frequency which decreases . . . at high frequencies.

In electric impedance measurements of erythrocytes

[1] Hemingway and McClendon, *Physics*, 2: 396, 1932.
[2] Proc. Am. Physical Soc., *Physical Review*, 35: 297, 1930.
[3] *Am. Jour. Physiol.*, 91: 83, 1929.
[4] SCIENCE, 83: 283, 1936.
[5] *Am. Jour. Physiol.*, 27: 240, 1910.
[6] *Phi. Tr. Roy. Soc. London*, (B) 207: 481, 1916.
[7] *Jour. Gen. Physiol.*, 12: 37, 1928.
[8] *Jour. Gen. Physiol.*, 18: 877, 1935.
[9] *Jour. Gen. Physiol.*, 19: 625, 1936.

I showed that with a Wheatstone bridge with equal ratio arms the only impedance that would balance the erythrocytes with a change of frequency of the measuring electric current from 500 to a million cycles

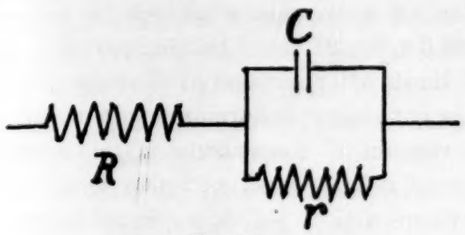

FIG. 1

per second (Fig. 1) was a resistance R in series with a "leaky condenser" consisting of a capacity C and a parallel resistance r, which must be discovered by trial and error. But time was saved by first setting R equal to the total impedance at the highest frequency. For instance, when the total impedance at a million cycles was 124 ohms, R was found to be 105 ohms. The closeness of these values is striking when it is noted that the total impedance at 500 cycles was 734 ohms.[10] At infinite frequency the total impedance would equal R, but technical difficulties with the Wheatstone bridge method and theoretical difficulties such as change of specific inductive capacity of water at very high frequencies led me to limit the high frequency at 1,500,000 cycles[11] and assume the total impedance at this frequency to equal R.

In a study of frog's skeletal muscle I showed[12] that the electric impedance decreased on stimulation, and in a later paper,[13] that the electric impedance of turtle's curarized skeletal muscle decreased when it was stimulated. This decrease in impedance was localized in the plasma membrane by showing that, on stimulation, R remained unaltered but r decreased whereas C appeared to increase.[14] This has been denied by Bozler[15] but confirmed by Dubuisson,[16] who made a great improvement in the technique by the use of the cathode ray oscillograph, with which he could determine the changes in impedance during a thousandth of a second (σ).

Dubuisson used the high frequency impedance for R, and then at low frequency determined C and r. On stimulating the muscle there was no change in R, but there were two time-changes in the other values. Three σ after stimulation r dropped 0.2 per cent. of its former value and rose again at 13 σ but fell again at 16 σ 8 per cent., and then rose again at 1000 σ. The changes in C were equal and opposite to those in r. The first wave is apparently due to increased permeability of plasma membranes of muscle *fibers* (corresponding to R wave of electromyogram), and the second wave to increased permeability of the *fibrillae* (corresponding to T wave of electromyogram).

It thus appears that the decrease in reactance (increased capacity) of the plasma membrane, as shown by Cole and others, represents an increased conductivity of the plasma membrane. The same conclusion was drawn by Hemingway and Collins.[17] They state that the tissue may be considered as a series of leaky condensers (namely, the cell membranes) and the low resistance cell interiors. In such a case one condenser, if considered as a thin plate of specific conductivity s and dielectric constant k, would have a resistance r and a capacity C.

$$C = \frac{ks}{4\pi}\frac{1}{r}$$

In other words, the less the resistance r the greater the apparent capacity C.

By spectral analysis I showed that the permeability of the unfertilized frog's egg to ions is low[18] but when fertilized, Na, K, Mg, Ca, Cl came out of them at an increased rate. Fahr[19] showed that resting skeletal muscle is impermeable to Na and K, but Fenn and Cobb[20] showed that stimulated muscle lost about 15 per cent. of its K, which was replaced by Na from the medium. In other words, the electric impedance studies are harmonious with chemical studies of permeability in the same way as I have shown for the blood corpuscles. Although the plasma membrane of the blood corpuscle is probably as highly resistant as serpentine stone, which may be used in electrical insulation, still it is sufficiently conducting to account for the diffusion of chloride ions (chloride shift) which takes place in the blood during its passage through the lungs.

J. F. MCCLENDON

UNIVERSITY OF MINNESOTA

[10] McClendon, *Jour. Biol. Chem.*, 69: 745, 1926, written before the paper by Philippson was read.
[11] McClendon, *Protoplasma*, 7: 561, 1926.
[12] *Am. Jour. Physiol.*, 29: 302, 1912.
[13] *Am. Jour. Physiol.*, 82: 525, 1927.
[14] McClendon, *Protoplasma*, 7: 561, 1926.
[15] The variation of electrical resistance of muscle during contraction. Proc. Am. Physiol. Soc., *Am. Jour. Physiol.*, 109: 14, 1934.
[16] Ionogrammes de la contraction musculaire: Actualités scientifiques et industrielles 246, Paris (1935) contains references to other workers.
[17] *Am. Jour. Physiol.*, 99: 338, 1932.
[18] *Am. Jour. Physiol.*, 38: 163, 1935.
[19] *Z. Biol.*, 52: 72, 1909.
[20] *Am. Jour. Physiol.*, 115: 345, 1936.

EXTRACTION OF VITAMIN B_1 FROM ADSORBATES

IN studies of concentration of vitamin B_1, the adsorption method of Seidell has been extensively used. There have been several methods of extraction of the vitamin from the adsorbate, including the original Seidell method of extraction with alkaline solutions, the aqueous alcoholic hydrochloric acid method of

Stuart[1] and the quinine sulfate method of Williams.[2] Recently, Cook and Carroll[3] have reported the successful use of pyridine solutions.

We have been studying the concentration of vitamin B_1 for the last two years and have made an extensive study of the extraction from the adsorbate. In general, the published methods have extracted the vitamin, but in most cases the yields were not high. The quinine sulfate method of Williams probably gave the best yields. Early in our work we observed that pyridine solutions extracted some vitamin from the adsorbate, but the yields were far from satisfactory. In marked contrast, we found that the acid salts, such as the hydrochloride of pyridine, quinoline, aniline and certain other nitrogen bases gave very high yields of vitamin; yields of 90 per cent. or better were ordinarily obtained. Even solutions of ammonium chloride gave better yields of vitamin than solutions of either ammonia or hydrochloric acid.

Aqueous, aqueous alcoholic or alcoholic solutions of some of the acid salts of these bases have been extensively used in our studies. A more detailed description of the procedure of extraction will be contained in a later publication.

Our studies appear to show that the acid salts of certain nitrogen bases have the property of freeing the vitamin B_1 from the fuller's earth or Lloyd's reagent. These salt solutions have a much more marked effect than either the base or the acid alone. In fact, our evidence indicates that a part at least of the extractive power of the nitrogen base or hydrochloric acid is due to the formation of acid salts with either the acid or the nitrogen bases adsorbed with the vitamin on the fuller's earth.

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VITAMIN C IN AN ESTRIN PRODUCING OVARIAN TUMOR

IT has been already indicated by the authors[1] that vitamin C seems to be related to the formation of progesterone in the corpus luteum, but not to the production of estrin in the ovary. Weight is added to this latter idea by an examination of a rare estrin-producing ovarian tumor which we were fortunate enough to obtain from an operation upon a 19-year-old girl.

The pathological and clinical aspects of this case are to be reported in detail by Drs. G. Y. Rusk, R. Rypins and A. Palmer. Hormone studies carried out by Dr. Allan Palmer[2] showed that the tumor contained the estrogenic equivalent of 11.7 γ theelin per gm desiccated tissue, and 50.0 γ per liter cyst fluid. The daily excretion of estrogenic substance in the urine was about 66.0 γ per 24 hours before operation, and fell to normal limits after removal of the tumor. All estimations for gonadotropic hormones were negative.

The vitamin C concentration was determined by titration of a 2 per cent. metaphosphoric acid extract of the tissue with 2, 6-dichlorophenol-indophenol, and was found to be 0.20 mg per gm fresh tissue. Using a technique previously employed,[3] it was estimated that fibrous tissue composed 18 per cent. of the weight of the tumor; hence if the reasonable assumption is made that practically all the vitamin C is contained in the parenchymal cells, it may be calculated that there is 0.24 mg of vitamin C per gm of parenchymatous tissue.

From the cell-counting procedure[4] the number of parenchymal cells per mg was found to be 712×10^3. It follows, then, that there is $\frac{0.24}{712 \times 10^3}$ or 0.34×10^{-6} vitamin C per cell.

Up to the time of operation the patient was on a high vitamin C diet.

The comparatively low concentration of vitamin C in this tissue, which has been generating estrin in large amounts, would emphasize the previous suggestion that vitamin C is unrelated to estrin formation in the ovary.

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AN ARTHROPOD VECTOR FOR EQUINE ENCEPHALOMYELITIS, WESTERN STRAIN[1]

IN a forthcoming report[2] we have described experiments which suggest that the "gopher," *Citellus richardsonii* (Sabine), may serve in nature as a reservoir host for the virus of equine encephalomyelitis, Western strain. We record this supplementary note at the present time to permit workers in the field to use

[1] E. H. Stuart, R. J. Block and G. R. Cowgill, *Jour. Biol. Chem.*, 105: 463, 1934.

[2] R. R. Williams, R. E. Waterman and J. C. Keresztesy, *Jour. Am. Chem. Soc.*, 56: 1187, 1934.

[3] C. A. Cook and R. H. Carroll, *Ind. and Eng. Chem.*, 28: 741, 1936.

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[2] Hormone studies were made possible by a grant from the Christine Breon Research Fund, the Department of Obstetrics and Gynecology of the University of California Medical School.

[3] D. Glick and G. R. Biskind, *Jour. Biol. Chem.*, 114: 1936.

[4] D. Glick and G. R. Biskind, *Jour. Biol. Chem.*, 110: 1935.

[1] From the Department of Bacteriology, University of Rochester, School of Medicine and Dentistry, Rochester, New York.

[2] Jerome T. Syverton and George Packer Berry. *Proc. Soc. Exp. Biol. and Med.* In press.

remaining summer months for the collection of potential hosts and natural vectors.

has been suggested that arachnids may serve as rs in the dissemination of equine encephalomye-. This suggestion has been substantiated experi-tally. The tick used was *Dermacentor andersoni* les)[3]. A 250 gram guinea pig was inoculated cerebrally with 0.12 cc. of brain tissue-equine phalomyelitis virus suspension. Eleven nymphs immediately placed on the guinea pig. Engorge-t was completed in 48 hours. Thirty-four days the resultant adult ticks, six females and five s, were placed on a "gopher." The "gopher" five days later. Brain tissue suspensions, unfil-, and as Berkefeld V and Berkefeld N filtrates, ted in equine encephalomyelitis on passage to ea pigs.

These preliminary observations indicate that ticks of the genus *Dermacentor* may act as vectors of equine encephalomyelitis, Western strain. As far as we are aware, this is the first time that a tick of the genus *Dermacentor* has been implicated in the transmission of a filterable virus disease. Further studies which include other ticks are now in progress. It is significant that the geographical distribution of the disease corresponds to that of this vector and of other ticks belonging to the same genus. The susceptibility to equine encephalomyelitis of the "gopher," *Citellus richardsonii* (Sabine), one member of a large group of closely related native rodents, many of them with a geographical distribution similar to that of the disease and the tick vector, has been reported.[2]

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE SPEED CONTROL FOR SMALL D. C. MOTORS

THE device described here furnishes a simple and ible means of securing, on short notice and over a range of values, steady rotational speeds ap-ble to light loads. It has been employed for ing baths, driving sector and siren disks, for oscopic determinations, producing and studying tions and waves, for lecture demonstrations and a variety of uses such that it has come to be a for both research and instruction. The design is ed, therefore, in the hope that workers in various s of laboratory will be interested. In principle akes use of well-known facts and, in construction, parts that are cheap and easily obtained. The par-lar combination, as far as the author is aware, is generally known. It has been given only a brief iption in a local journal[1] and a demonstration re a public audience.[2]

wo units enter into its assembly: a D. C. shunt or and a control board. The principle utilized sts in reducing the potential on the armature inals without changing that on the field magnet speeds slower than the designed normal speed desired, while for speeds above normal the field net is weakened, while the potential on the arma-is kept at full value. A potential divider is used ccomplish this. Series resistances could be em-ployed to secure this type of regulation, but the potential divider has two advantages: first, its resistance is not critical; second, at the lower speeds, the power output is greater. Thus, at 1/3 normal speed for a certain ⅓ H. P. motor, the output with the potential divider was 10 times that with series control.

Figure 1 shows the wiring diagram for the control

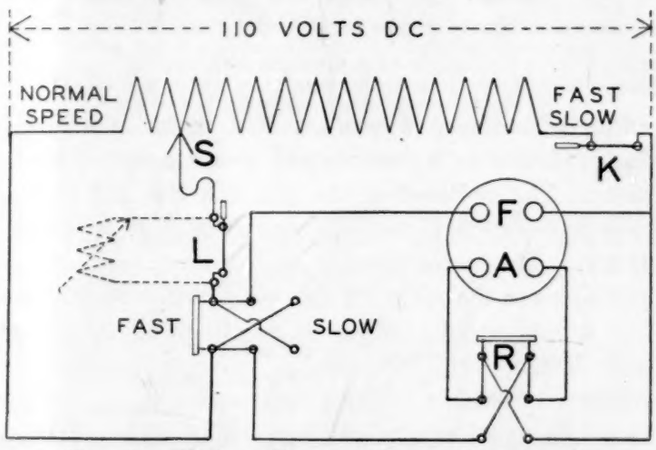

FIG. 1. Wiring diagram for control board.

board. The terminals of the field and armature are plugged in at F and A, respectively, using a standard receptacle to fit the base of an outworn radio tube with connecting flexible cable (three to four feet long for general purposes) of four stranded leads between motor and plug. The control board in turn is plugged through a lamp cord to the mains whose potential is applied across the potential divider as indicated. Of the two double pole double throw switches, R is for reversing the direction of rotation and the other, or "fast-slow" switch, is for running above or below normal, respectively. It will be observed that as the

We are much indebted to Dr. C. B. Philip, U. S. Pub-Health Service, Hamilton, Montana, through whose esy we were able to obtain ticks.

[1] *University of Virginia Journal of Engineering*, 5: 1924.

[2] *Proceedings*, Virginia Academy of Science, 1924–5, 8.

slider S is moved to the right the speed will rise from normal; while, if the fast-slow switch is thrown on "Slow," the same sliding operation will cause the speed to drop continuously from normal to zero. To stop the motor this switch is opened and, to stop the current through the potential divider, K is opened.

Somewhat unusual conditions occur when continuous running at or close to normal speeds or when finer gradation in regulation is required. For the first case K may be left open to reduce waste in heat, while, in the second, L is opened and a low resistance rheostat is inserted as shown by the dotted lines.

Figure 2, drawn from a photograph, shows an example of a set-up where a $\frac{1}{8}$ H.P. motor is adapted for mounting in a clamp stand in a number of positions. The switches at the top and the left of the diagram are the L and K switches of Fig. 1, respectively. The remainder is self-explanatory, except perhaps for the scale. This, while little used, shows the speeds corresponding to positions of the slider and brings out, incidentally, their approximately linear relationship. The normal speed in this motor is shown as 34 revolutions per second. The effective range in speeds is from about 1 or 2 r.p.s. to around 100 r.p.s., depending upon the load. The resistance of the potential divider may be anything from 50 to 200 ohms. Two hundred ohms wastes less in heat (about 50 watts) than 50 ohms (about 200 watts), but it is better not to go much over 200 ohms, for that would probably cut down the power output of the motor to an undesirable extent. The head shown on the shaft consists of a cone of small pulleys ended off with a washer and clamp screw for mounting disks, extra pulleys, drums and the like. On the tip is soldered a small wire loop for hanging objects to be spun vertically. Direct coupling to various apparatus is effected by short lengths of rubber tubing.

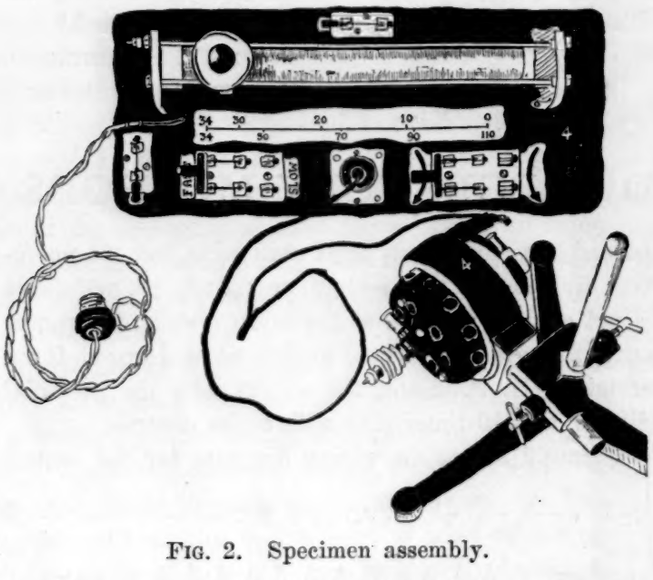

Fig. 2. Specimen assembly.

In equipping our laboratory with small motors, [the] same size of shaft ($\frac{1}{4}$ inch) has been adhered to [for] the sake of interchangeability. This is easily d[one] from the lists of dealers in second-hand "rebu[ilt]" electrical machinery. The control boards are [also] interchangeable, although that is of secondary imp[or]tance. The method has been applied to the $\frac{1}{4}$ H[.P.] size, but in the larger sizes one would have to consi[der] the power loss. The $\frac{1}{8}$ H.P. size is most frequen[tly] employed, although a number of $\frac{1}{4}$ H.P. motors are [in] use. A variant on the principle is to divide [the] potential at the source, say, in the case of storage b[at]teries where the intermediate potentials may be tapp[ed] off or in a 3-wire system) where both 220 and [110] volts are available. There is an advantage to [be] gained (not shown in Fig. 2) in the employment [of] a rheostat provided with a slow motion drive for [the] slider.

Some of the disadvantages of this design are [ob]viously its limitation to D. C. supply, reduction [of] the full power output and the heat loss in the pot[en]tial divider, the last named being trifling for the sm[all] sizes. On the other hand, some of its advantages [are] flexibility, freedom from change-speed accessor[ies] such as gears or intermediate pulleys, and its pr[ac]tically fool-proof characteristic. The main prec[au]tion is to avoid stalling the armature too long, es[pe]cially in the high-speed ranges. Only one mo[tor], however, has been burned out, and that was due [to] this cause, although these motors have been hand[led] by hundreds of students and others over a period [of] more than twelve years. I am indebted to Mr. J[ohn] C. Wyllie, of the University Library, for the ske[tch] of Fig. 2.

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